CLAIMS

1. A modulating apparatus in a mobile communication system that performs data communication at a rate for transmitting 2400 multi-value symbols per second, characterized by comprising:

a base band filter that blocks an unnecessary frequency component of a multi-value symbol inputted and outputs a waveform signal; and

frequency shifting and modulating means for shifting to modulate a frequency of an output signal according to a magnitude of an amplitude of the waveform signal inputted from the base band filter, and in that

the frequency shifting and modulating means is adjusted such that, when a symbol having a maximum absolute value is inputted, an output signal has an absolute value of a frequency shift in a range of 0.822[kHz] to 0.952[kHz].

2. A modulating apparatus in a mobile communication system that performs data communication at a transmission rate of 2400×(n+1) (n: natural number) [bps], characterized by comprising:

symbol converting means for sequentially converting a binary signal generated by encoding predetermined data into a $2^{(n+1)}$-ary symbol, which includes $(2^{(n+1)}+1-2k)$ $(1 \leq k \leq 2^{(n+1)})$ values, (n+1) bits at a time and outputting the symbol;

a base band filter that blocks an unnecessary

frequency component of a symbol inputted from the symbol converting means and outputs a waveform signal; and

frequency shifting and modulating means for shifting to modulate a frequency of an output signal according to a magnitude of an amplitude of the waveform signal inputted from the base band filter, and in that

when a symbol of $\pm(2^{(n+1)}-1)$ is outputted from the symbol converting means, a frequency shift of the output signal from the frequency shifting and modulating means is set to take a value in a range of ±0.822[kHz] to ±0.952[kHz].

3. The modulating apparatus according to claim 1 or 2, characterized in that the base band filter is a Nyquist filter.

4. A mobile communication system comprising:

a transmitter that performs transmission of data at a transmission rate of 2400×(n+1) (n: natural number) [bps]; and

a receiver that receives data transmitted from the transmitter, characterized in that

the transmitter includes:

encoding means for encoding predetermined data to generate a binary signal;

symbol converting means for sequentially converting a binary signal generated by the encoding means into a $2^{(n+1)}$-ary symbol, which includes $(2^{(n+1)}+1$-

2k) ($1 \leq k \leq 2^{(n+1)}$) values, (n+1) bits at a time and outputting the symbol;

a first base band filter that blocks an unnecessary frequency component of a symbol inputted from the symbol converting means and outputs a waveform signal; and

frequency shifting and modulating (FM) means for transmitting a signal, which is obtained by shifting to modulate a frequency according to a magnitude of an amplitude of the waveform signal inputted from the first base band filter, to the receiver,

the receiver includes:

demodulating means for demodulating the signal transmitted from the transmitter and received and outputting a $2^{(n+1)}$-ary signal;

a second base band filter that blocks an unnecessary frequency component of the $2^{(n+1)}$-ary signal outputted from the modulating means and outputs the $2^{(n+1)}$-ary signal;

binary signal converting means for sequentially converting a $2^{(n+1)}$-ary signal inputted from the second base band filter into a binary signal of (n+1) bits and outputting the binary signal; and

decoding means for decoding a binary signal inputted from the binary signal generating means and outputting the predetermined data, and

when a symbol of $\pm(2^{(n+1)}-1)$ is outputted from the symbol converting means, a frequency shift of a signal outputted from the frequency shifting and modulating means is set in a range of ±0.822[kHz] to ±0.952[kHz].

5. The mobile communication system according to claim 4, characterized in that the first and second base band filters are Nyquist filters.

6. The mobile communication system according to claim 4 or 5, characterized in that

the first base band filter includes a root raised cosine filter and a sinc filter,

the second base band filter includes a root raised cosine filter and a 1/sinc filter that has a characteristic opposite to that of the sinc filter, and

a nominal frequency shift of the symbol of $\pm(2^{(n+1)}-1)$ is set to a value $\pi / 2\sqrt{2}$ times as large as a frequency shift of a signal outputted from the frequency shifting and modulating means.

7. The mobile communication system according to claim 4 or 5, characterized in that

the first and second base band filters include root raised cosine filters, and

the nominal frequency shift of the symbol of $\pm(2^{(n+1)}-1)$ is set to a value $1 / \sqrt{2}$ times as large as a frequency shift of a signal outputted from the frequency shifting and modulating means.

8. The mobile communication system according to claim 4 or 5, characterized in that

the first base band filter includes a raised cosine filter and a 1/sinc filter,

the second base band filter includes a sinc filter that has a characteristic opposite to that of the 1/sinc filter, and

the nominal frequency shift of the symbol of $\pm(2^{(n+1)}-1)$ is set to a value $2/\pi$ times as large as a frequency shift of a signal outputted from the frequency shifting and modulating means.

9. A modulating method in a mobile communication system that performs data communication at a rate for transmitting 2400 multi-value symbols per second, characterized by comprising:

a step of blocking an unnecessary frequency component of a multi-value symbol inputted and outputting a waveform signal; and

a frequency shifting and modulating step of shifting to modulate a frequency of an output signal according to a magnitude of an amplitude of the waveform signal inputted, and in that

in the frequency shifting and modulating step, signal processing is performed such that, when a symbol having a maximum absolute value is inputted, an output signal has an absolute value of a frequency shift in a range of 0.822[kHz] to 0.952[kHz].

10. A modulating method in a mobile communication system that performs data communication at a transmission rate of 2400×(n+1) (n: natural number) [bps], characterized by comprising:

a symbol converting step of sequentially

converting a binary signal generated by encoding predetermined data into a $2^{(n+1)}$-ary symbol, which includes $(2^{(n+1)}+1-2k)$ $(1 \leq k \leq 2^{(n+1)})$ values, (n+1) bits at a time and outputting the symbol;

a step of blocking an unnecessary frequency component of a symbol inputted from the symbol converting means and outputting a waveform signal; and

a frequency shifting and modulating step of shifting to modulate a frequency of an output signal according to a magnitude of an amplitude of the waveform signal inputted, and in that

when a symbol of $\pm(2^{(n+1)}-1)$ is outputted from the symbol converting step, a frequency shift of the output signal from the frequency shifting and modulating step is set in a range of ±0.822[kHz] to ±0.952[kHz].

11. A communication method in a mobile communication system including a transmitter that performs transmission of data at a transmission rate of 2400×(n+1) (n: natural number) [bps] and a receiver that receives data transmitted from the transmitter, characterized by comprising:

an encoding step of encoding predetermined data to generate a binary signal;

a symbol converting step of sequentially converting a binary signal generated by the encoding step into a $2^{(n+1)}$-ary symbol, which includes $(2^{(n+1)}+1-2k)$ $(1 \leq k \leq 2^{(n+1)})$ values, (n+1) bits at a time and outputting the symbol;

a step of blocking an unnecessary frequency component of a symbol inputted from the symbol converting step and outputting a waveform signal;

a frequency shifting and modulating step of transmitting a signal, which is obtained by shifting to modulate a frequency according to a magnitude of an amplitude of the waveform signal inputted from the first base band filter, to the receiver;

a demodulating step of demodulating the signal transmitted from the transmitter and received and outputting a $2^{(n+1)}$-ary signal;

a step of blocking an unnecessary frequency component of the $2^{(n+1)}$-ary signal outputted from the modulating step and outputting the $2^{(n+1)}$-ary signal;

a binary signal converting step of sequentially converting a $2^{(n+1)}$-ary signal inputted into a binary signal of (n+1) bits and outputting the binary signal; and

a decoding step of decoding a binary signal inputted from the binary signal generating step and outputting the predetermined data, and in that

when a symbol of $\pm(2^{(n+1)}-1)$ is outputted from the symbol converting step, a frequency shift of a signal outputted from the frequency shifting and modulating step is set to take a value in a range of ±0.822[kHz] to ±0.952[kHz].